

Square Wave Modulated Charging-Control Circuit For A Flash Unit Of A Camera

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

The present invention relates to circuitry for a flash unit, and in particular, to an easy-to-control charging circuit for the capacitor of a camera flash unit. The charging circuit includes a modulator for modulating the charging current supplied to the capacitor according to the voltage state of a power 10 supply of the camera, in order to reduce a load on the micro control unit (MCU) and also to avoid fast decreases in battery voltage during charging, thereby prolonging the useful life of the flash unit power supply and of the flash unit itself.

2. Description of the Prior Art

15 Devices such as a traditional camera, digital camera or cellular phone with camera are regularly equipped with a flash unit in order to cope with the underexposure problem. The flash unit is usually powered by a battery of the camera, or an alternating current (AC), with the relatively large voltage necessary to achieve a "flash" being supplied by a flash unit 20 capacitor.

Fig. 1 shows a known flash unit charging circuit 2, including a flash unit capacitor 21, induction coil 22, capacitor 23, transformer 24, diode 25, resistances 26a~26d, transistors 27a, and field effect transistors 27b, and in which one end of the charging circuit 2 is connected to a battery 1 and 25 another end is connected to a control pin 4 arranged to receive a control signal sent by a micro control unit/MCU (not shown). When the control pin 4 receives the control signal, the charging circuit 2 will allow the charging current I_c (average current) to charge the flash unit capacitor 21. However, because the control signal must be sustained during the charging period, 30 the MCU suffers a relatively great load.

In order to shorten the time necessary to charge the flash unit capacitor 21, the charging current I_c is always kept at a relatively high level that leads to a rapid decrease in the voltage of the battery 1. Therefore, the MCU will

detect a state of "battery low" so as to shut off the function of the flash unit. Even though the battery is still useable, the detection of a "battery low" condition will force a user to replace the battery promptly.

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SUMMARY OF THE INVENTION

It is an object of the present invention to provide a flash unit charging circuit that eliminates the burden on the MCU of the flash unit.

It is another object of the present invention to provide a control circuit that modulates the charging current so as to extend the life span of the
10 battery.

In order to accomplish these objects, the present invention provides a control circuit including a flash unit capacitor, a voltage converter, and a square-wave oscillator that eliminates the need for continuous control of the charging cycle by the MCU. Furthermore, the voltage converter includes
15 a current control circuit arranged such that, when the voltage of the battery is relatively low, the control circuit will regulate the charging current to reduce the rate of decrease in the voltage of the battery. Therefore, the lifespan of the battery 1 is efficiently extended, albeit at the cost of lengthening the time necessary to charge the flash unit capacitor.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a current diagram according to a prior art.

FIG. 2 is a block diagram of the present invention.

FIG. 3 is a current diagram of the present invention.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following detailed description is of the best presently contemplated modes of carrying out the invention. This description is not to be taken in
30 a limiting sense, but is made merely for the purpose of illustrating general principles of embodiments of the invention. The scope of the invention is best defined by the appended claims.

Referring to FIGS. 2 and 3, the flash unit charging-control circuit 5 includes a flash unit capacitor 51, a square-wave oscillator 52, and a voltage converter 53. The charging-control circuit 5 is connected to a power supply, such as a battery 1. The square-wave oscillator 52 has a 5 comparator 521, capacitor 522, and resistances 523~527. Both the comparator 521 and the resistances 527 are connected to the Vcc respectively, and the square-wave oscillator 52 is connected to the control pin F_CHG as to receive a flash unit-enabling signal via a charge-enabling circuit 55. The charge-enabling circuit 55 further includes transistors 551 10 and 552, and resistances 553~555. Resistance 555 is directly connected to the Vcc.

When the camera detects the usage of the flash unit, the MCU will send a flash unit-enabling H (high) state signal to the control pin F_CHG, causing the charge-enabling circuit 55 to activate the square-wave oscillator 52 and 15 generate a square wave signal. The square wave signal in turn causes the transistor 531 to keep turning "ON" and "OFF," resulting in an intermittent supply of charging current to the capacitor, in which the charging current/ I_c (average current) will charge the flash unit capacitor 51 according to the duty cycle of the square-wave. This relieves a substantial 20 burden on the MCU, thereby greatly increasing its efficiency.

When the charging process is completed, the MCU will send a flash unit-enabling L (low) state signal to the control pin F_CHG, causing the charge-enabling circuit 55 to inactivate the square-wave oscillator 52 and end generation of the square wave signal. The transistor 531 will 25 therefore remain in an "OFF" state, stopping the charging process.

The voltage converter 53 includes a current control circuit 54, transistors 531, 532, transformer 533, diode 534, and resistances 535, 536. The transistor 531 connects to the battery 1 as to receive the charging current I_c and charge the flash unit capacitor 51. The current control circuit 54 is 30 located between the transistors 531 and 532, which consists of transistor 541, resistances 542~544. The resistance 542 connects the control pin F_CHG1 so as to receive a current control signal from the MCU.

When the battery 1 is full, the MCU will send an H (high) state signal to the control pin F_CHG1 such that the current control circuit 54 will activate

the transistor 541 (ON). Therefore, the flash unit capacitor 51 can be charged quickly by a large amount of I_c (average current). However, when the voltage of battery 1 becomes lower, the MCU will send an L (low) state signal to the control pin F_CHG1 such that the current control circuit 54 will
5 close the transistor 541 (OFF) and only allow a small amount of I_c to pass. Therefore, the MCU won't detect the fast decreasing voltage (battery low) of the battery 1 promptly. Though the time-consuming of charging process is become longer, the life span of the battery 1 is correspondingly extended.

10 Those skilled in the art will appreciate that the current control circuit 54 can control the transistor 541 in an analogous manner to vary the average current I_c according to the voltage of the battery 1. In addition, the concept of the present invention can be applied to any device which needs a flash unit. Also, the circuits of the present invention can be formed as a single
15 integrated circuit (IC) so as to save space in a limited housing.

While the description above refers to particular embodiments of the present invention, it will be understood that many modifications may be made without departing from the spirit thereof. The accompanying claims are intended to cover such modifications as would fall within the true scope
20 and spirit of the present invention.